California Environmental Protection Agency

Air Resources Board

# Research Division

***The Research Division of ARB provides sound scientific information for actions to protect people and the environment from the effects of air pollution in California.***

Inside:



## Research Division Mission and Responsibilities

The Air Resources Board (ARB) research program was established by the Legislature in 1971 (Health and Safety Code Sections 39700 et seq.) as an integral part of a broad-based statewide effort to combat air pollution and protect and enhance the ambient air quality of California. The program is mandated to coordinate and collect the research data needed to develop a better understanding of the aspects of air pollution, including: 1) the chemical composition of pollutants, 2) the identification and nature of the source of pollutants, 3) the mechanisms of pollutant emission and transport, 4) the chemistry and physics of atmospheric reactions that form or decompose pollutants, 5) the effects of air pollution on health and the environment, 6) the impact of air pollution on California's economy, and 7) approaches to reducing emissions and the associated health, environmental, and economic impacts. The ARB sponsors a comprehensive program of research addressing the causes, effects, and possible solutions to air pollution problems in California, and provides support for establishing ambient air quality standards. In recent years, several legislative mandates have expanded and further defined the scope of the program.

The ARB works toward developing short- and long-range objectives that address existing and potential issues related to air pollution. The effectiveness of California's air pollution control program depends, primarily, on the quality of the public policy decisions that define its actions. The broad goal of the ARB research program is to provide the timely scientific and technical information needed to develop and support these decisions. The relevant problems addressed in these policy decisions are identified by the Legislature, the Board, ARB staff, local air pollution control districts, the academic community, and ARB research advisory committees.

ARB's research program is managed by the Research Division. The Division establishes contracts with private entities, universities, and governmental agencies, whose scientists carry out most of the projects. Division staff responsible for planning and overseeing this research are expert in a wide range of disciplines. Once all phases of a project are completed, a final research report, containing all findings, is prepared and submitted to ARB for review. When approved, the final report is published and distributed to the air regulatory community, libraries, and universities. Summaries of the reports, known as *Research Notes,* are available on the ARB Internet webpage (www.arb.ca.gov) and in written form, by request.

In addition to directing and performing research, the Division provides information that assists the Board in setting ambient air quality standards, performs economic analyses in support of the Board's regulatory programs and enforcement efforts, and operates the ARB Technical Library. Informational brochures and fact sheets on a variety of air pollution topics are also developed and made available to researchers, environmental and educational organizations, and the general public.

# Health Effects Research Program

A sound understanding of the health impacts of ambient air pollution is essential if the ARB is to meet its mandate—the protection of public health and welfare. Focused research activities, sponsored by the Health Effects Research Program at ARB, provide the information base for this understanding. Current projects are evaluating how asthmatics are impacted by smoke from agricultural burning, how particles in air impact the heart health of elderly people, and how particle size and chemistry interact to damage lungs. In addition to the broad, statewide focus of these studies, certain areas manifest health trends that demand specific attention. On-going investigations of this nature include how ambient air pollution impacts hospitalizations and health care use in people who reside in the San Joaquin Valley and how community exposure to volatile compounds impacts children with asthma in areas where petrochemical processing plants exist .

Our most ambitious effort to date stems from the Long-Term Exposure Health Effects Research Program. The program was established by ARB, with legislative and gubernatorial support, to identify and quantify the effects long-term air pollution exposure has on public health. The core of this program is an epidemiological research project, called the Children's Health Study (CHS), that is unique in scope and focus. This study was initiated as a 10-year effort and is currently in its seventh year. Each year, approximately four thousand school children from 12 different communities in the southern part of the state undergo lung testing and are tracked for any occurrence of acute respiratory illness. The growth of each child's lungs is followed until they graduate from high school. The investigators in this study report that lung growth in children from the most polluted communities lags behind lung growth found in cleaner communities. The ARB provides the primary funding and staff support for the project, which has an annual budget of approximately two million dollars. Assistance with air quality monitoring in the study communities is provided by local air quality districts, including San Luis Obispo, San Diego, and the South Coast Air Quality Management District (which has contributed some funds to the project. The United States Environmental Protection Agency has also provided the ARB with funds in support of CHS. This program, along with other ARB health research activities, is conducted in coordination with projects sponsored federal, local, and other state agencies.

*"The investigators in this study report that lung growth in children from the most polluted communities lags behind lung growth found in cleaner communities."*

Children and the elderly are particularly sensitive to pollutants

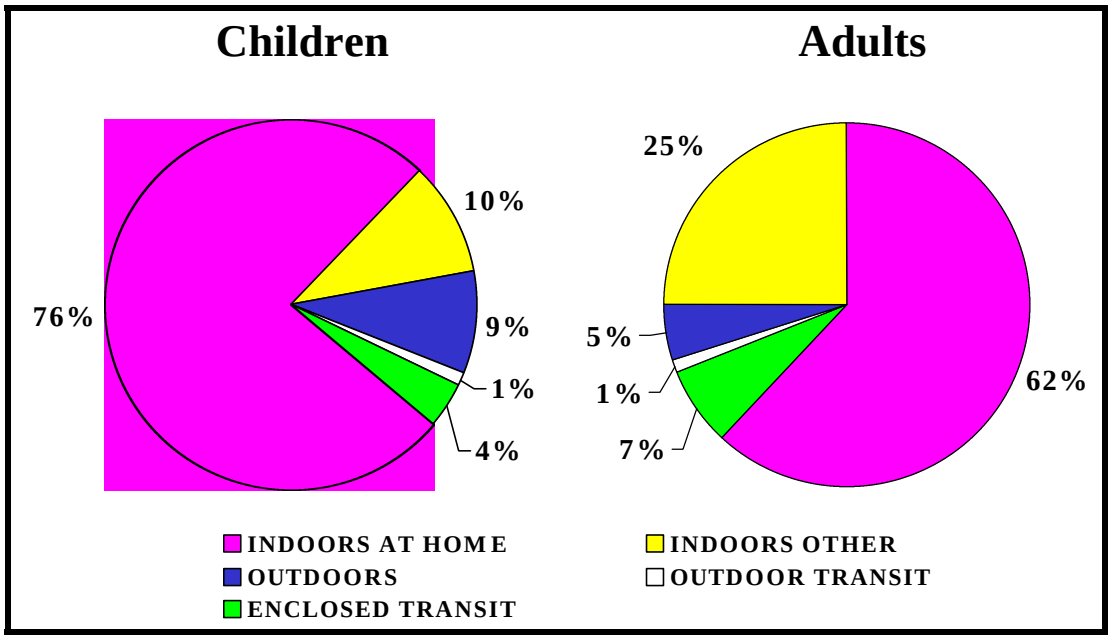
# Indoor Air Quality and Personal Exposure Assessment Program

The Air Resources Board's Indoor Air Quality and Personal Exposure Assessment Program (Indoor Program) was established in 1986 to study all aspects of indoor pollution and determine ways to reduce Californians' exposures to indoor pollutants. The Indoor Program is recognized as a leader in sponsoring pioneering research on all aspects of indoor air quality and exposure assessment. All of the Indoor Program's studies have involved the use or application of newly developed technology and have notably advanced the science of exposure assessment. The success and significance of the projects funded under the Indoor Program are reflected in the extensive use of the data by scientists and government agencies worldwide.

Program staff also prepare indoor exposure assessments for pollutants identified by ARB as toxic air contaminants, as required under Health and Safety Code Section 39660.5. Most recently, staff used a newly-developed indoor exposure model to estimate Californians' exposures to diesel exhaust particles; a model that allowed ARB to provide, for the first time, a range of estimated exposures rather than just a simple average.

Because the Indoor Program is a non-regulatory program, it must rely on public education and cooperative efforts to lower risks. The Indoor Program publishes health-based, indoor air quality guidelines to inform the public about indoor sources of pollution and actions they can take to reduce their exposures. The first two guidelines, on formaldehyde and combustion pollutants, have been in high demand. Guidelines for chlorinated pollutants, ozone, and particles are under development. The Indoor Program also published a very popular booklet entitled "Reducing Indoor Air Pollution" that was designated a Notable State Publication in the *1993 Government Publications Review*.

Program staff also work cooperatively with other agencies and organizations involved in indoor air quality research and risk reduction. They serve on a national technical committee to develop voluntary, consensus indoor product emissions standards and serve as the ARB representative on the California Indoor Air Quality Interagency Working Group chaired by the Department of Health Services. They have participated on a national carbon monoxide detector task force and have served on many advisory panels and committees. They have also serve as invited peer reviewers and technical advisors for the U.S. Environmental Protection Agency, U.S. OSHA, the Canadian government, and many others.




Time Californians Spend in Different Environments

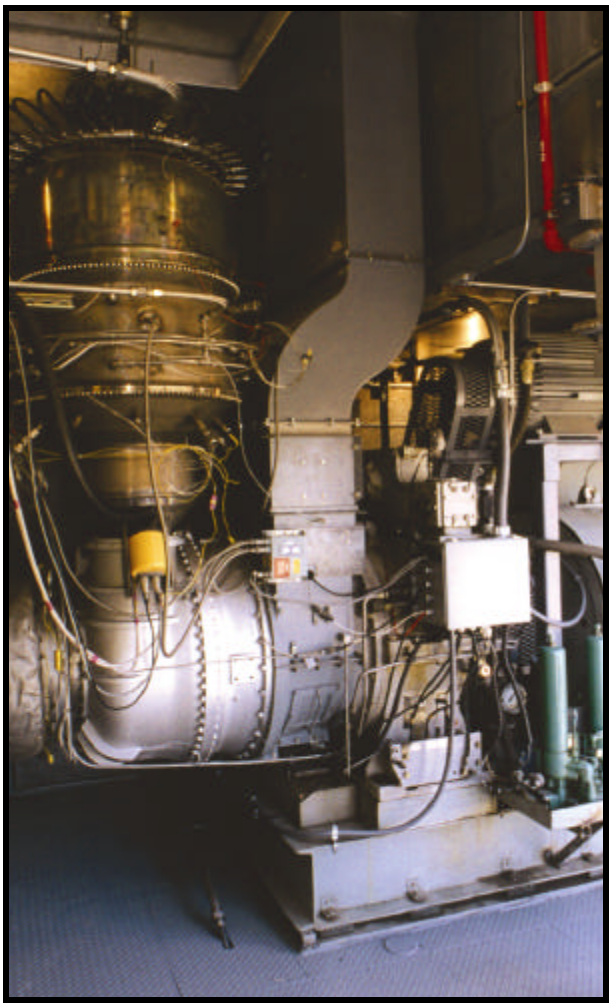
# Innovative Clean Air Technologies Program

The Innovative Clean Air Technologies (ICAT) program assists in the development, demonstration, and commercialization of broad-based technologies designed to reduce air pollution within the State, as well as create jobs within the related industries. The ICAT program is currently allocating approximately $1 million annually to support these projects.

One recent project focused on the reduction of emissions from electricity-generating gas turbines, which are significant contributors of oxides of nitrogen ($NO_x$) in California. Current emission control technologies can reduce $NO_x$ emissions. However, these technologies are expensive. Using an on-site, experimental-scale combustor, Catalytica Combustion Systems has demonstrated the performance of a new kind of catalytic combustion process, called XONON. This process is more cost effective than other available technologies.

Another project addressed the evaporation of solvents used in paints, which represents an important source of volatile organic compound (VOC) emissions. With ICAT funding, AVES Incorporated (AVES) and the Adhesive Coatings Company (ADCO) developed and demonstrated a metal coating system that contains zero-VOCs and no hazardous air pollutants. Results from these demonstrations provided the data for the performance, cost analysis, and environmental study reports necessary to a successful commercial rollout. ADCO has signed a licensing agreement and has recently received its first order from National RV, a recreational vehicle manufacturing company. AVES received national recognition for this development in the form of the 1998 NICE³ (National Industrial Competitiveness through Energy, Environment, and Economics) award from the U.S. Department of Energy. This grant will support the continued deployment of this innovative process. By phasing in low-VOC and zero-VOC coatings, industries could reduce air emissions and costs without installing expensive add-on controls.

Since 1994, the ICAT Program has provided over $2.5 million in co-funding for projects designed to develop and demonstrate technologies that reduce air pollution. The development and commercialization of new and improved clean air technologies will help California meet its clean air goals while stimulating the economy and offering new opportunities to associated industries.



Catalytica's XONON installation in Santa Clara

Program staff greatly streamlined the ICAT pre-proposal process by creating a "business" friendly solicitation package. In addition, to improve program awareness within the business community, news on completed projects, as well as general information and guidelines for participating in the ICAT program, is now available in *Update*, a semi-annual newsletter, and on the Internet at www.arb.ca.gov/research/icat/icat.htm. The proposal review process is also coordinated with the California Energy Commission and the South Coast Air Quality Management District.

## The PM Research Program

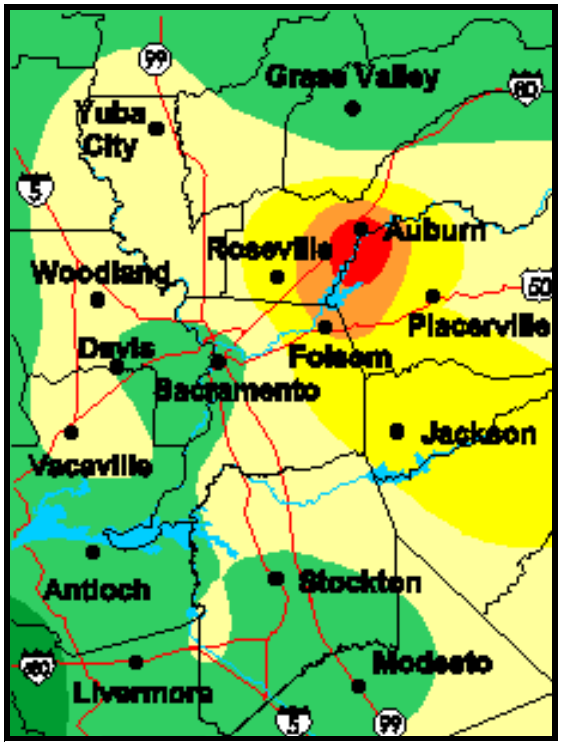
Particulate matter (PM) in the air is of clear public and regulatory concern in California. It adversely impacts health and impairs visibility. The particles of most concern have a diameter smaller than 10 micrometers (PM10) and can easily pass into the lung. These particles contain toxic chemicals; some of which are known to cause cancer. Others cause lung tissue damage and are implicated in worsened heart function, asthma, other respiratory diseases, and even increased rates of hospital admissions and deaths. Recently, smaller particles (PM2.5) have been implicated as the cause of some of these health impacts.

For over twenty years, the ARB has conducted a comprehensive program of research on PM emissions, including their measurement and modeling; visibility reducing particulate haze; particulate emissions control; and the health effects of particulate air pollution. Results from these studies are essential in the development and refinement of the State Implementation Plan, PM control strategies, and air quality standards. Accurate, up-to-date information also allows ARB to monitor the public health, environmental, and economic effects of PM; evaluate current control efforts in different regions of the state; document progress toward specific goals; and identify potential problems. The program is also designed to recognize the unique character of each region while continuing to address statewide issues that are common among regions.

## Atmospheric Chemistry and Physics Research Program

The quality and effectiveness of California's air pollution control programs and standards depend on access to the most complete and policy-relevant scientific information available. The first studies of the chemistry and physics of air pollution began in California when Dr. Arie Haagen-Smit determined how ozone was formed. This groundbreaking research provided the basis for ARB's ozone control strategy, which targets both hydrocarbons and nitrogen oxides emissions. The Atmospheric Chemistry and Physics Research Program is the primary source for information needed to adequately address both current and future air quality control issues.

ARB sponsored research has significantly increased understanding of the pollution process and resulted in improved air pollution monitoring methods, improved air quality models for ozone and particulate matter, and more flexible control strategies. However, California still exceeds health-based ambient air quality standards and more sophisticated approaches are needed to avoid future problems. To address these concerns, the ARB continues to fund research on the influence of emissions, meteorology, and the chemistry of air pollution formation, in an effort to develop the most appropriate, efficient, technically defensible, and cost-effective regulatory programs possible.




Ground level ozone mapping provides a method of verifying air quality models

## Economic Analysis

The Research Division's Economic Studies section provides economic and financial information to ARB and a wide range of public and private businesses and institutions. In response to legislative mandates, this section estimates the costs of proposed ARB regulations and assesses the resulting economic impacts on California business and industry (jobs, competitiveness, and development), consumers, and the economy as a whole. In addition, the section's Cal/EPA Agency-Wide Economic Analysis Unit assists all Cal/EPA boards and departments in assessing the business impact of any regulations proposed by their offices. Financial strength analyses of businesses that are requesting variances or are subject to penalties are provided for ARB's Compliance, Stationary, and Mobile Source divisions, and the Office of Legal Affairs.

The Economic Studies section also develops ideas, designs studies, and manages research contracts that provide the economic basis for effectively implementing ARB's air quality management plans. These projects address such issues as market-based strategies for reducing emissions; effective modeling for economic forecasting; the effects of air pollution on California's economy (especially agribusiness); and improved methods for estimating the economic impacts of Cal/EPA regulations on individuals and the business community.

The economic impacts of ozone-damaged crops are studied by the Economic Studies section

## Atmospheric Acidity Protection Program

Beginning in 1983, ARB sponsored studies on acid deposition under the Kapiloff Acid Deposition Act. When this program ended, the Legislature directed the Board to continue research in this area. The Board initiated the Atmospheric Acidity Protection Program (AAPP) to implement this directive. Research focus areas under this program included investigation of the effects of atmospheric acidity on lake, forests, human health, and economically significant materials, and the study of atmospheric processes involved in acidity formation and transport. The majority of the AAPP project research was completed by 1996. However, assessment of the impacts of acid deposition in California is ongoing. ARB staff, in conjunction with researchers in this field, are continuing to analyze the information gathered over the past ten years. Results and recommendations from these studies will be used by the Board to determine if atmospheric acidity and acid deposition standards are needed to protect sensitive ecosystems and human health.

## Ambient Air Quality Standards

The levels identified in federal and state ambient air quality standards define acceptable air quality in California and are based on the need to prevent or minimize the adverse effects of air pollution upon health, vegetation, and other aspects of the environment. These standards also serve as references against which the progress of air quality control programs is measured. In these ways, ambient air quality standards provide the basis for air pollution control and, as the State's air quality goals, form the foundation for most of ARB's air pollution control programs. The ARB is mandated by the State and the California Health and Safety Code Section 39606 to adopt standards of air quality for each [air] basin in consideration of the public health, safety, and welfare.

The Research Division supports the Board in fulfilling its mandate by regularly reviewing existing air quality standards for scientific validity, identifying the scientific basis for revising air quality standards, and determining actions needed to meet regulatory requirements. The Division, in cooperation with Cal/EPA's Office of Environmental Health Hazard Assessment, uses the most recent peer-reviewed scientific data to aid the Board in making informed decisions. It also sponsors research projects that investigate both the health and ecological effects of ambient air pollutants. Health effects studies have evaluated sensitive population sub-groups and investigated the effects of carbon monoxide, ozone, particulates, pollutant mixtures, and other pollutants on human health. Ecological projects have investigated the effect of ozone on forests and the impact of air pollution on the yield of important commercial crops. Certain projects, such as the Long-Term Exposure Health Effects Research Program, integrate the resources and data of the Health Effects Research with several other Research Division programs.

The Research Division helps the Air Resources Board to define appropriate air quality standards

## Technical Library

The Technical Library, operated by the Research Division, is a resource utilized by all ARB divisions. It contains technical publications and resource materials, including books, reports, magazines, and journals. Library staff are also available to perform on-line computer-based literature searches and can retrieve documents from other libraries, greatly multiplying the library's effective holdings. Although this is primarily an ARB resource, other agencies and the public are welcome to utilize its reference collections.

**Air Resources Board**

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